The Builder.

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ALL parties seem now to agree with us in the opinion, that the accident to the Dee Bridge occurred, not through the failure of the masonry, or any accidental blow, but from the ribs being too weak to carry their own weight, the weight of the roadway, and the traffic.

The nonsense that has been talked during the inquiry, either for the purpose of shifting the blame, and throwing dust into the eyes of the public, or want of knowledge, must have been read with astonishment by those who are quietly looking on without interested feelings. The result, it is to be hoped, will at least have the effect of inducing some gentlemen, who have been raised by a series of lucky accidents into a position of great authority, to distrust their own infallibility (into a belief of which they have been persuaded by foolish adulators), and to give such consideration to works entrusted to them as their importance, involving the safety of the public, demands.

Railway engineers have become too speculative, too self-sufficient, and too careless: and railway directors are often too *exigent*. The endeavour to keep within the estimate, and to keep within the time, has produced much bad work; and want of care and over-weening sufficiency have led to more. Premiums have been offered both to engineers and contractors to slight the works; and it is scarcely to be wondered at, that in many cases the bribe has been taken without objection. There is, however, another party who ought to be (but is not) considered in these arrangements,—poor, credulous Mr. Bull, who pins his faith to any name that is often mentioned, and will take any thing for granted 'till he is once led to mistrust. This is a party who *must* be cared for, and it behoves the government to see that it is done.

Great excitement was caused by the failure in question, and this has been increased by the reported failure of a girder bridge recently constructed over the Tame, near Tamworth, for the Trent Valley Railway. According to the *Worcester Journal*, apprehensions had been entertained for its safety for some little time past, and a man was appointed to watch the progress of any defect which might be observable in the structure, either from subsidence or other causes. This bridge consists of three divisions of about 70 feet span, supported by two piers in the bed of the stream, the line being formed by iron girders, and the whole being constructed on a principle precisely similar to that of the bridge over the Dee, on the Chester Railway, where the late melancholy accident occurred. "It appeared that the doubts entertained as to the stability of the structure did not originate without sufficient cause, as on Monday the man appointed to watch the bridge perceived that one of the immense iron girders was giving way. The circumstance was immediately reported to the officers of the company, and measures will no doubt be taken not only to repair the fracture, but to ascertain the perfect stability of the work, before the opening of the line for traffic. On the whole, it is a matter of congratulation that the state of the bridge was discovered thus early, as, had it given way during the passing of the trains, the consequence would have been frightful to contemplate."*

The fall of the arch in Bermondsey has further increased the excitement, and has produced us, in addition to many which had reached us before from all parts of the country, a pile of letters on the subject. Some of the former complain bitterly that similar girder-bridges, in progress in their various localities, are not suspended. The form is undoubtedly a bad one; the mode of trussing, from the upper corner of each end, *above the line of compression*, down towards the lower edge of the girder, is worse than useless.

We would suggest, that government, to appease the public mind, should obtain a report from competent persons, on every similar bridge now being constructed.

To make our record perfect, and afford as much information as possible, we return to the inquiry at Chester, which has now closed.

Mr. Broad, in reply to an inquiry, whether the girders "were tested by pairs, or promiscuously," said "they were tried in pairs. It was quite possible that two girders of the same strength might be made from the same mould. They were all cast from two patterns, and he should think their relative strength was about the same. The girders now standing were about the same strength as that which had failed."

The foreman of the jury wished to ask Mr. Stephenson, how it was, that in all the short bridges of 30 feet span, the girders were assisted by timbers, so that if the former gave way, the latter would still stand, yet that here, where the span was much greater, there was no such support.

Mr. Stephenson said, in a bridge of 100 feet span, the timbers would have been an absurdity; they were applied to bridges of a smaller span, as mere matters of convenience, without at all contributing to their safety.

Thomas Jones proved, that he was looking at the bridge when the train passed, and observed *a crack open at the bottom of the girder in the centre*. When pressed as to this important fact, he said he was quite certain, that the girder opened from the bottom, and not from the top.

Mr. Kennedy, an iron master, considered the bridge strong enough for its purpose, and thought it was broken by a blow, or by the extra weight of ballast trains upon it on the same day. The iron girder was capable of carrying 70 tons in the centre without the tension rods; if the rods were not properly adjusted, he thought the bridge would not be safe for ordinary traffic.

Evidence was given contradictory of the opinion, that the carriages were off the line, and had struck the girder.

Thomas Taylor saw the carriages fall. Before they fell, saw the *girder "belly" in the middle*.

Mr. Robertson, the engineer to the Shrewsbury and Chester Railway, put in the following report, which deserves attention. It was accompanied by a model.

"You will perceive that there are two principal fractures in the beam, one near the centre, 5¼ feet from the joint in the middle portion of the girder; the other in the portion of the girder next to the abutment, and 20 feet from its bearing; the latter fracture appears to me, from its form, and especially from the position in which the fragments lay, as shewn in the ground plan taken the morning after the accident, to have been caused by the fall; any disturbing cause previously to the fall is quite inconsistent with the close proximity of the fragments.

The fracture at the centre, from the position of the fallen portions, and of the middle tension rods wrapped over the girder, and especially from the form of the fracture, appears to me to have first taken place. This fracture I consider to have resulted from the weakness of the top flange of the girder, which was compressed and broken by the strain arising from the rolling weight of the engine and train, and the vibratory weight of the structure itself, increased to a large extent by the deposit of 25 tons of ballast on the roadway immediately before the accident. This compression is remarkably evident, by the bulging out of the metal at the point of fracture, at the top of the web or vertical portion of the girder.

In estimating the strength of the girder, I am of opinion, that the tension rods, from the form of the section of the girder, tended to weaken it, and to throw an undue strain, by compression on the top flange; but, assuming that they did not weaken it, and applying the formula as given by Eaton Hodgkinson, F.R.S., to the girders—by one formula the breaking weight is equal to 61½ tons; and by the other, the breaking weight is equal to 71 tons. Now, it has been an established rule in practice, that ½d or ⅓th of the breaking weight is the safe working weight to which a girder should be subjected; and the larger the size, the smaller ought to be the proportion taken.—therefore, ½ of 76 (the breaking weight); it follows, that the safe weight to which one of the girders ought to be subjected is 15½ tons, and the two girders 37 tons.

The weight of the timber platform, beams, rails, chains, &c., exclusive of the girder, according to an approximate calculation I have made, is 19 tons 6 cwt.; and adopting the rule, that a uniform weight, diffused over a beam, is equivalent to one-half that weight suspended at the centre, this becomes equal to a weight suspended at the centre of 9 tons 13 cwt.

The equivalent weight of an engine and tender of 33 tons 10 cwt. 2 qrs. suspended at the centre of the beam, I estimate at 32 tons, making a strain of 41 tons 13 cwt., against 37 tons, the safe working strain to which the bridge ought to be subjected.

However, on the afternoon of the accident, immediately previous to the passing of the train, the bridge was subjected to an additional strain by the laying on of 5 inches of broken red sandstone ballast, amounting to a weight over the bridge of 25 tons, which is equivalent to a weight suspended at the centre of 12 tons 10 cwt.

This makes a total of 57 tons against the safe strain of 37 tons formerly stated; and this last addition appears to me to be the immediate cause of the accident.

In these calculations, however, it is assumed that every thing is at rest, and that the forces applied are those resulting from direct pressure; while the evidence shews that there is a vibratory movement of the whole structure to a large extent; and there is besides the percussive movement of the engine and tender, which, with a heavy long boiler engine with outside cylinder, is considerable. The weight of the structure and of the train in motion will be about 164 tons in all; and the strain from this cause must be added to that formerly stated.

This strain, although it cannot be ascertained by accuracy of calculation founded on experiment, experience shews to be great; and I am of opinion, that it formed a large element in the strain which broke the bridge down.

There is also the whole gross strain arising from the pressure, and the percussion of the structure and its load, the apportionment of that strain between the girders; for I am of opinion that from the loose and independent connection of the girders, and the living of the structure, the strain may have been equally divided between the girders. These investigations, independently of the evidence of the eye witnesses, lead me to the conclusion that the girder broke in the middle from its weakness to resist the strain increased by the laying on of the ballast.

The opinions of Mr. Stephenson and Mr. Locke, founded on the alleged facts as to the paint on the tender, the broken carriage wheel, and the snips in the chairs, appear to fall to

* A viaduct, which carried the new line of railway over the river Neurthe, between Avricourt and Marsellise, and was just ready to be opened, is reported to have fallen in, with an immense sacrifice of money.

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